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Climate and geomorphic risks in high-mountain environments

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Abstract: Glacier Hazards, Permafrost Hazards, and Glacier Lake Outburst Floods in Mountain Areas: Processes, Assessment, Prevention, Mitigation; Vienna, Austria, 10–13 November 2009; Recent atmospheric warming is profoundly affecting high-mountain environments around the world. Glaciers are thinning and retreating, new and often unstable lakes are forming at glacier margins, other lakes are suddenly draining, and permafrost is degrading. These changes pose serious hazards to people and property in mountain valleys. Several tens of thousands of people were killed by landslides, floods, and debris flows from high-mountain regions during the twentieth century, and there is concern that such events will increase as temperatures warm through the 21st century.

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Research (Beijing) extended the impact of the conference.

The meeting was cosponsored by the China-U.S. Joint Research Center for Ecosystem and Environmental Change (<http://>

iss.e.utk.edu/jrceec/), established in 2006 to promote research collaboration, academic exchange, student education, and technology training and transfer in areas of environmental concern.

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Climate and Geomorphic Risks in High-Mountain Environments

Glacier Hazards, Permafrost Hazards, and Glacier Lake Outburst Floods in Mountain Areas: Processes, Assessment, Prevention, Mitigation; Vienna, Austria, 10–13 November 2009

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Recent atmospheric warming is profoundly affecting high-mountain environments around the world. Glaciers are thinning and retreating, new and often unstable lakes are forming at glacier margins, other lakes are suddenly draining, and permafrost is degrading. These changes pose serious hazards to people and property in mountain valleys. Several tens of thousands of people were killed by landslides, floods, and debris flows from high-mountain regions during the twentieth century, and there is concern that such events will increase as temperatures warm through the 21st century.

More than 70 scientists and risk managers met at a workshop in Austria to assess the current situation, review state-of-the-art methods for assessment of the impacts of climate change on mountains, and discuss strategies for risk management. The workshop was organized by the Working Group on Glacier and Permafrost Hazards in Mountains (GAPHAZ) of the International Association of Cryospheric Sciences (IACS) and

the International Permafrost Association (IPA), and was supported by the University of Natural Resources and Applied Life Sciences (BOKU), Vienna, and the Mountain Research Initiative (MRI).

A key point that surfaced repeatedly during the workshop is that rapid environmental change occurring in mountains is increasingly leading to conditions with little or no historic precedent. Glacier lakes have formed where ice existed only a short time ago, and slopes that have been frozen for millennia are thawing, creating new rock-fall and rock avalanche hazards. Landslides that enter glacial lakes can trigger catastrophic outburst floods, and eruptions on snow- and glacier-clad volcanoes can generate massive debris flows. Such process cascades have caused particularly severe disasters in the past and must be understood by emergency planners and decision makers for future prevention and mitigation. In some areas, the retreat or disappearance of glaciers may reduce the associated hazards or produce new types of hazards, participants noted.

Participants also discussed recent advances in technology for monitoring high-mountain environments, including ground-based, airborne, and spaceborne lidar (light detection and ranging), interferometric synthetic aperture radar (InSAR), ground-penetrating radar (GPR), electrical resistivity, and microseismic monitoring. Low-cost technology, focusing on satellite remote sensing, is particularly important for remote high-mountain areas in developing countries, such as the Himalayas or Andes.

A key outcome of the workshop was the recognition that high-mountain hazards and risks must be addressed using integrative, interdisciplinary strategies. There is a need to better integrate social, cultural, economic, and political dimensions with physical and engineering approaches. Participants recognized that better prediction of physical phenomena will not translate into lower losses if issues of vulnerability, often due to poverty and sociopolitical powerlessness, are not addressed within an overall disaster risk reduction strategy. Such strategies should be embedded in broader climate change adaptation measures.

This report benefited from input by Greg Greenwood, John Clague, Stephen Evans, Markus Stoffel, and many other session chairs and participants.

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ABOUT AGU

AGU Journals Among Most Cited Publications in Climate Change Research

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Geophysical Research Letters (GRL) and *Journal of Geophysical Research-Atmospheres* (JGR-D) both ranked among the top 10 of the most highly cited research

publications on climate change over the past decade in a recent analysis by sciencewatch.com, an Internet tool published by the Thomson Reuters Web of Science® that tracks trends and performances in basic research. Although *Nature*

and *Science*—the multidisciplinary heavyweights—led the field, *GRL* ranked fifth and *JGR-D* ranked sixth.

The study was conducted by searching the Web of Science® database for terms such as “global warming,” “climate change,” “human impact,” and other key phrases in journal articles published and cited between 1999 and the spring of 2009. The analysis produced over 28,000 papers, from which sciencewatch.com identified the most cited institutions, authors, and journals. To see the analysis in full, visit <http://sciencewatch.com/ana/fea/09novdecFea/>.

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